FLORIDA A&M UNIVERSITY

Excellence With Caring

Aerial Adulticiding

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Characterization of permethrin flux

- Permethrin has just been labeled for aerial application in Florida Mosquito Control
- Highly toxic to aquatic non targets
- Identify interactions between primary parameters and their effects on control and non target mortality
  - meteorological change, drop size and altitude
- Here we shall only discuss deposition and non target mortality

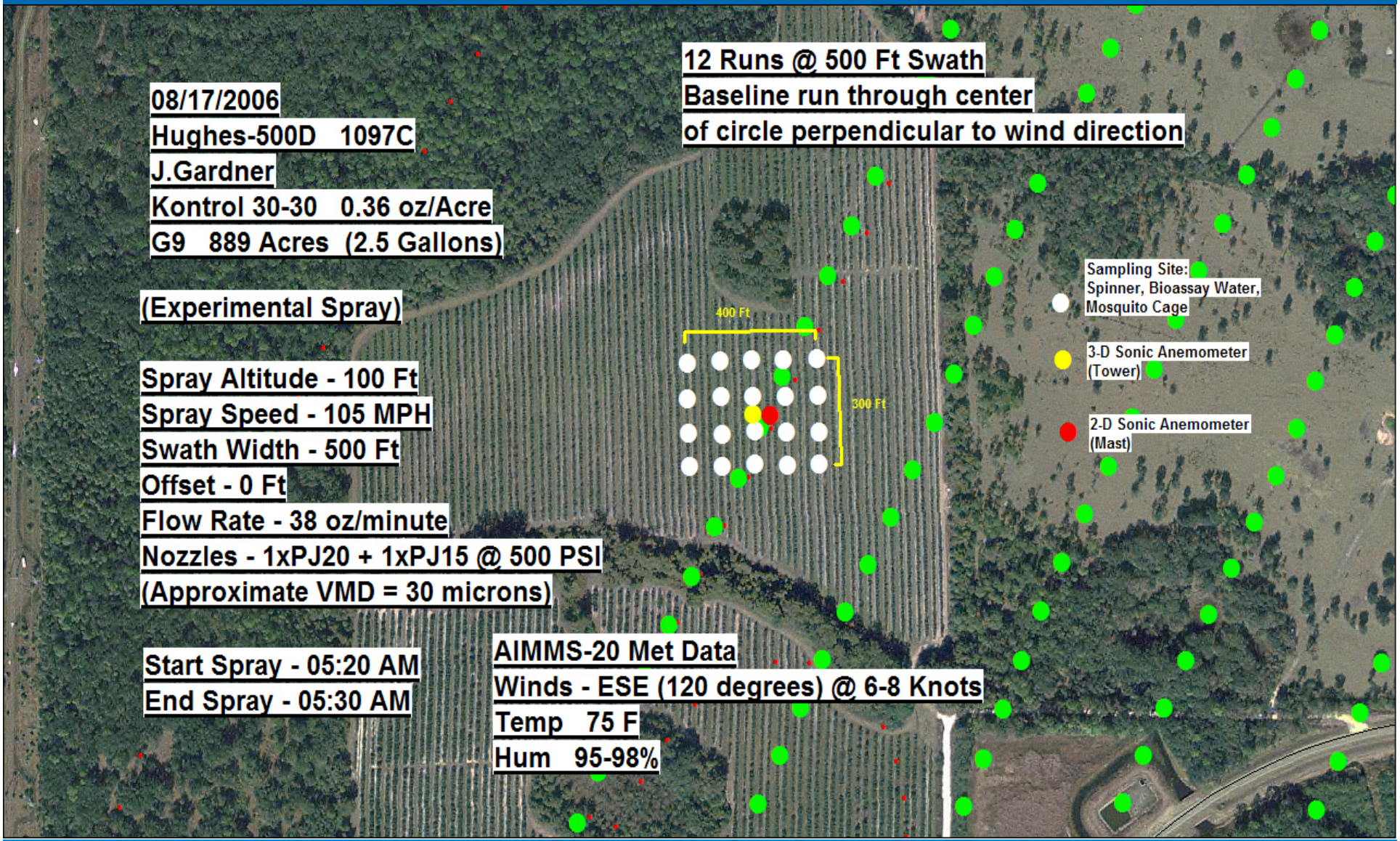
Mosquito Adulticiding

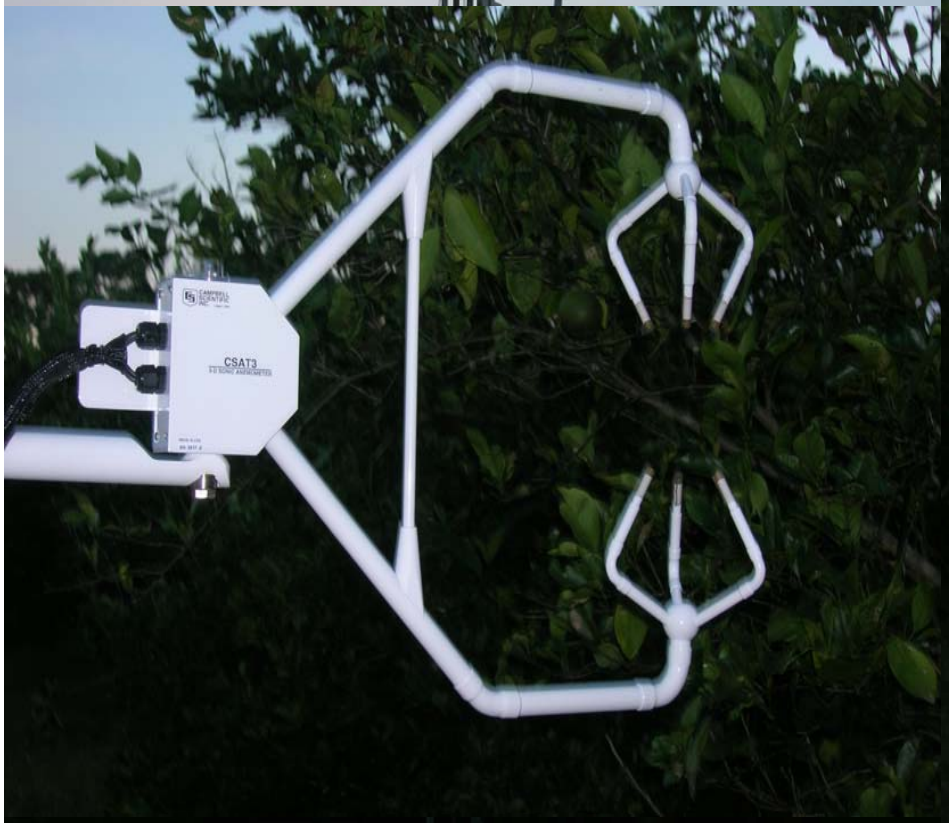
- In mosquito adulticiding the target is the mosquito on the wing
- Therefore we must fly when the mosquito flies
- The chemical needs to stay airborne and not deposit for two reasons
  - Chemical will be lost to the mosquitoes
  - Chemical will be available to non targets

Deposition: Non Target Mortality

- The EPA are deeply concerned about ground deposits
- They have gathered aquatic organism end points for permethrin from which **No Observable Affect Environmental Concentrations NOAEC** are extrapolated
- We can not exceed these end points

Experimental Protocol

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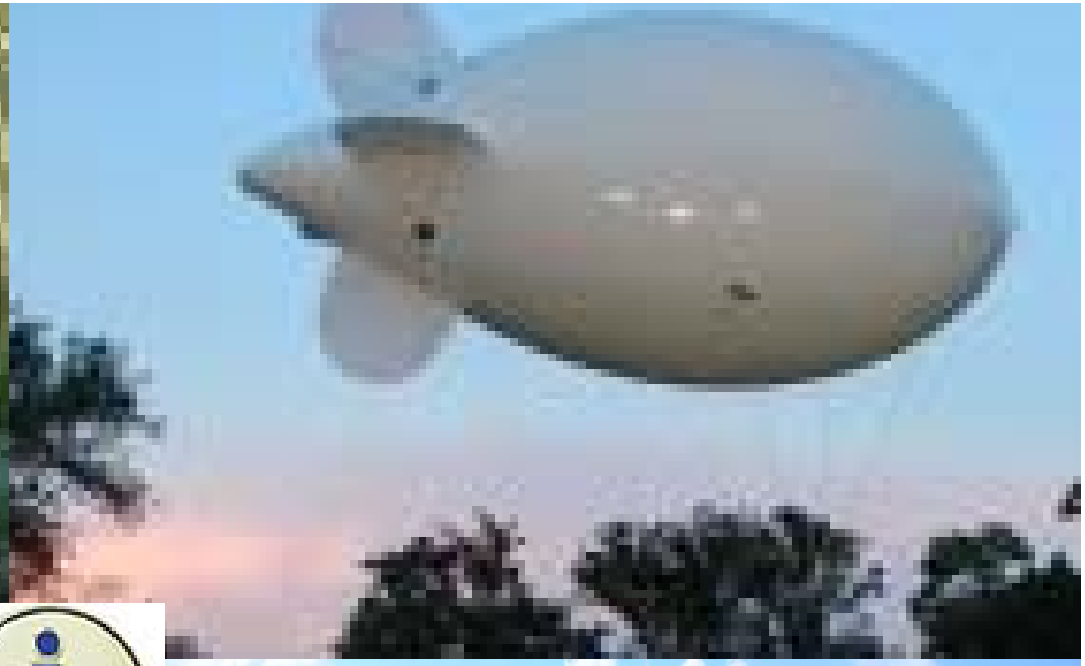
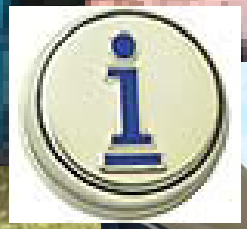




Deposition: Physical and biological measures

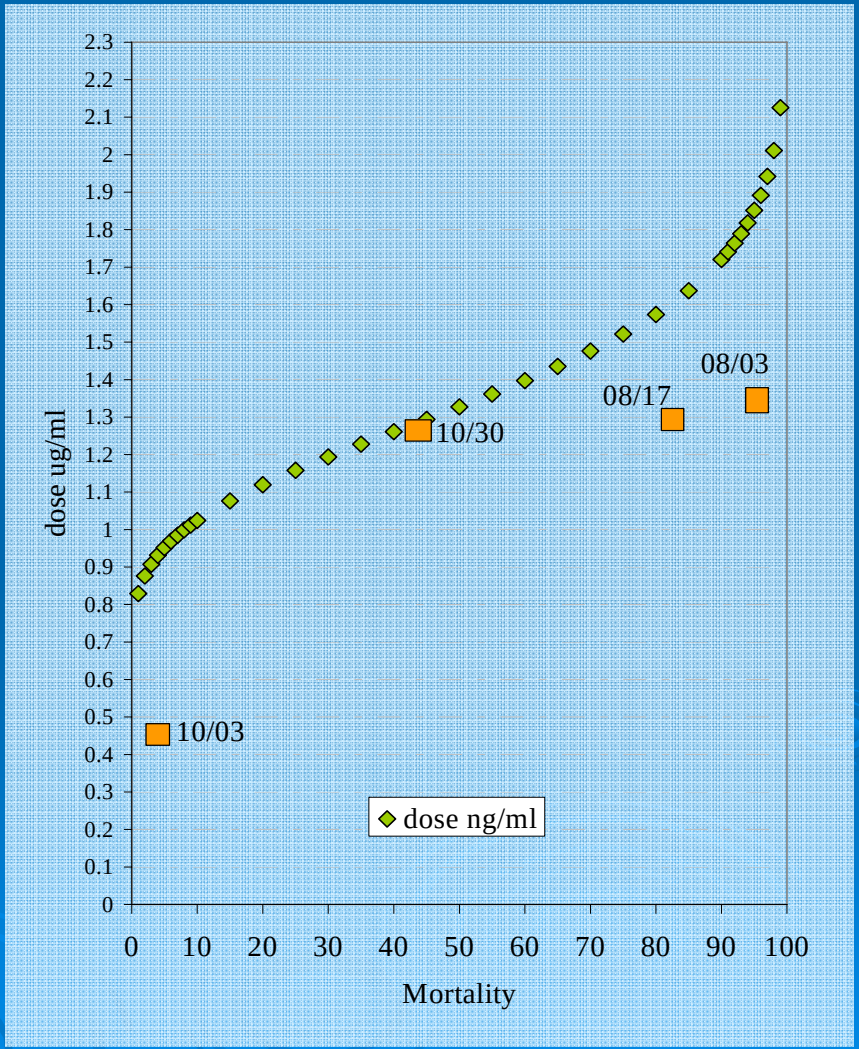
Deposition

To date four tests have been conducted

Deposits and non target mortality has occurred on each test

Deposition: Dose response, field dose and mortality

- EPA, Acute toxicity range for permethrin = 0.1 - 210 ppb
- Laboratory dose response shows an LC50 at 1.3 ppb our non target is very sensitive
- The bioassay and filter provides us with a deposit amount that can be extrapolated into the toxicology models



Aquatic Organisms End Points

Table 35. Permethrin toxicity reference values (ppb of active ingredient) for aquatic organisms.

Exposure scenario	Species	Exposure duration	Toxicity reference value (ppb)	Reference
Freshwater Fish				
Acute	Bluegill sunfish	96 hours	LC_{50} =0.79 ppb	ESF3 Supplemental
Chronic	Fathead minnow	Full life cycle	NOAEC = 0.30 ppb LOAEC = 0.41 ppb	ACC 096689 Supplemental Core
Freshwater Invertebrates				
Acute	*Hexagenia bilineata*	48 hours	EC_{50} = 0.1 ppb	MRID 23648 Core

Fresh water invertebrates NOAEC 0.039ppb

Estuarine/Marine Fish				
Acute	Atlantic silverside	96 hours	LC_{50} = 2.2 ppb	EPA (1987) Supplemental
Chronic	Sheepshead minnow	28 day early life stage	NOAEC 0.83 ppb[1] LOAEC 10 ppb	Hansen *et al.* (1983) Supplemental
Estuarine/Marine Invertebrates				

Marine invertebrates NOAEC 0.011ppb

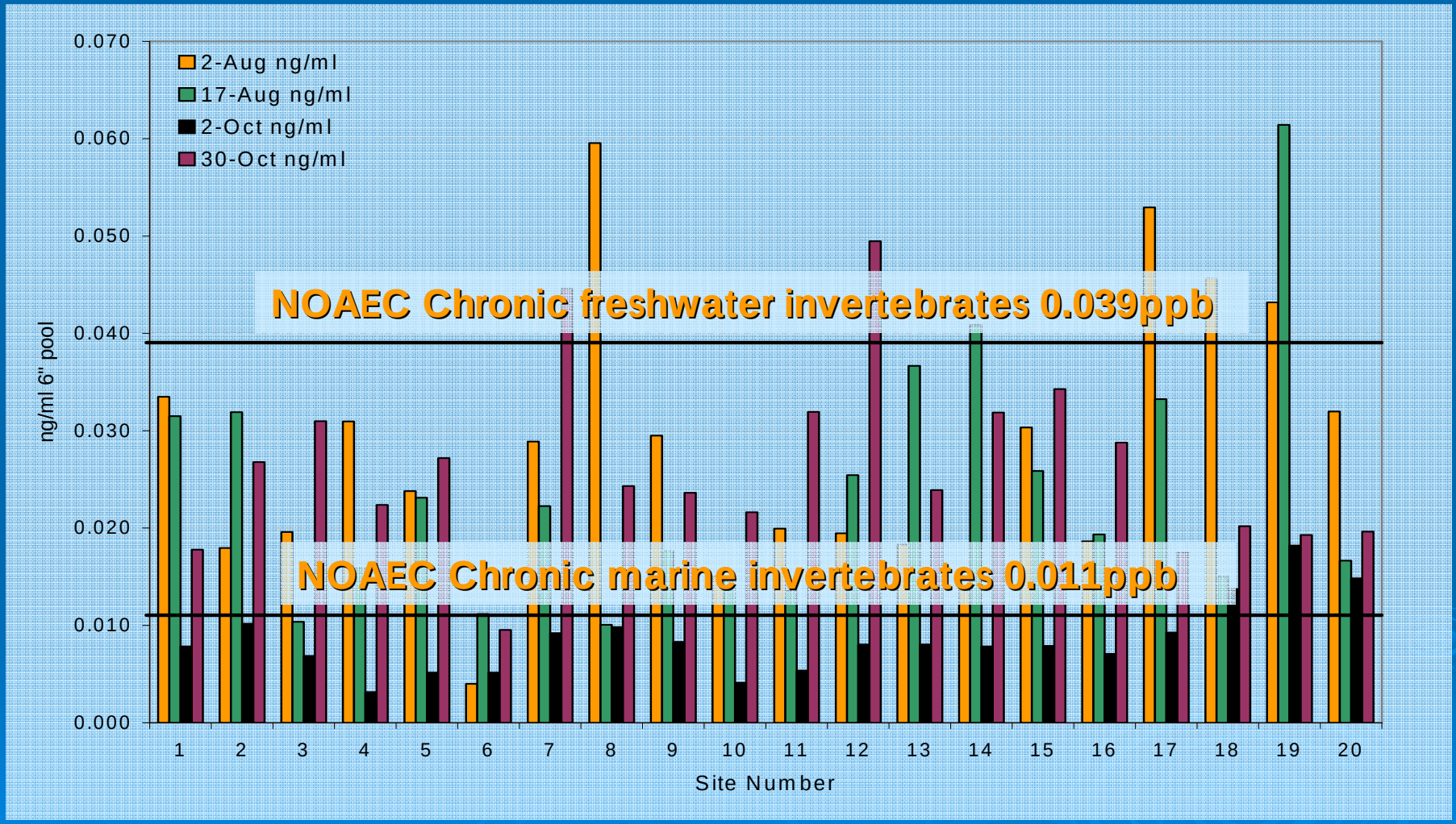
Chronic	Mysid shrimp	30 day life cycle	Mortality: NOAEC = 0.011 ppb LOAEC = 0.024 ppb	MRID 41315701 Supplemental study

[1] The estuarine/marine chronic value is extrapolated by using an acute/chronic ratio method of available data from similar species (0.79/0.30 : 2.2/x = 0.83 ppb).

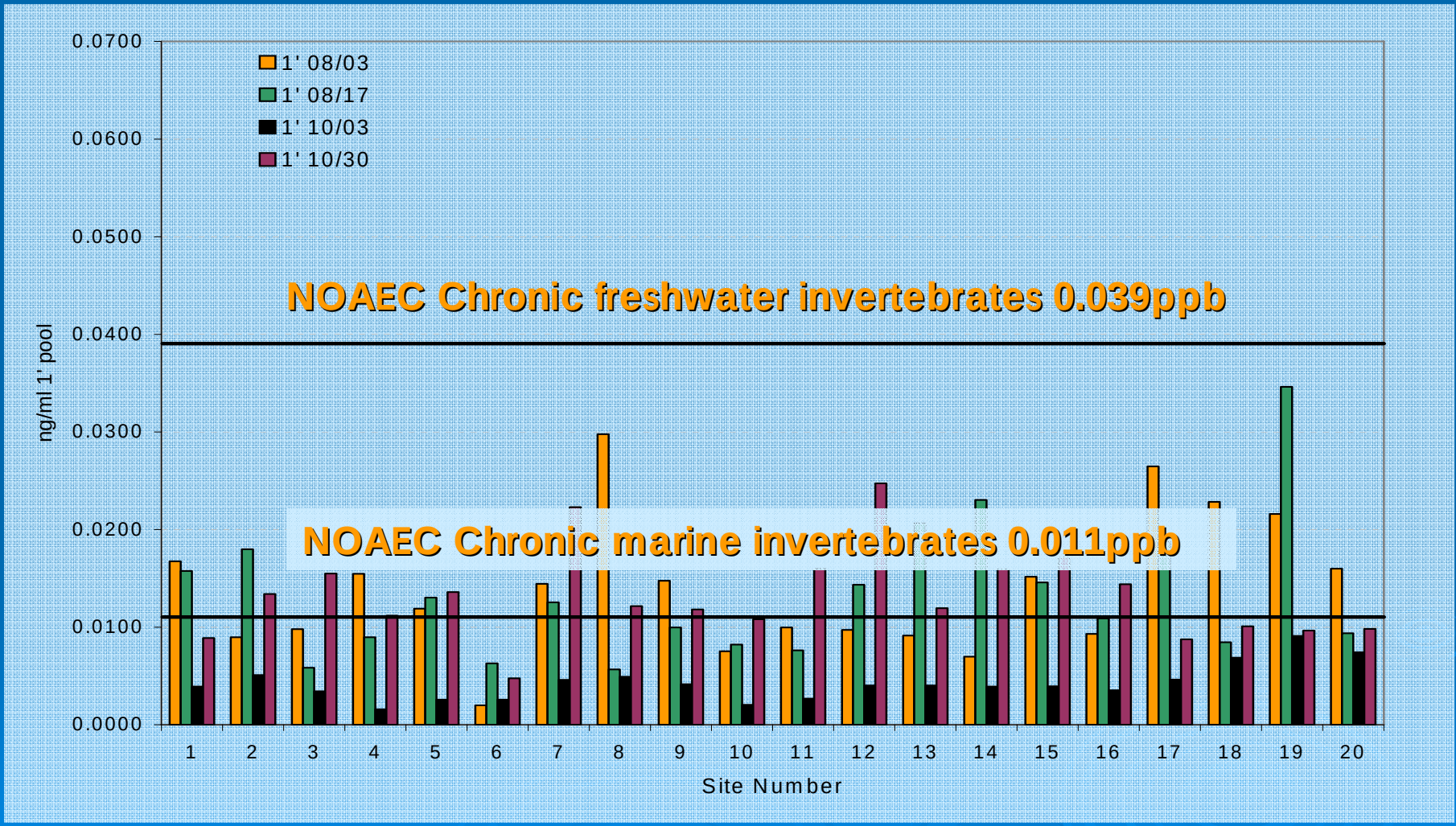
Concentration of deposits

- The NOAEC is a concentration the environmental toxicologists use with four different water body depths
  - 6” pool
  - 1’ pool
  - 1m pool
  - 2m pool
- The 2m pool is the standard water body used in the modeling of appropriate nozzle systems

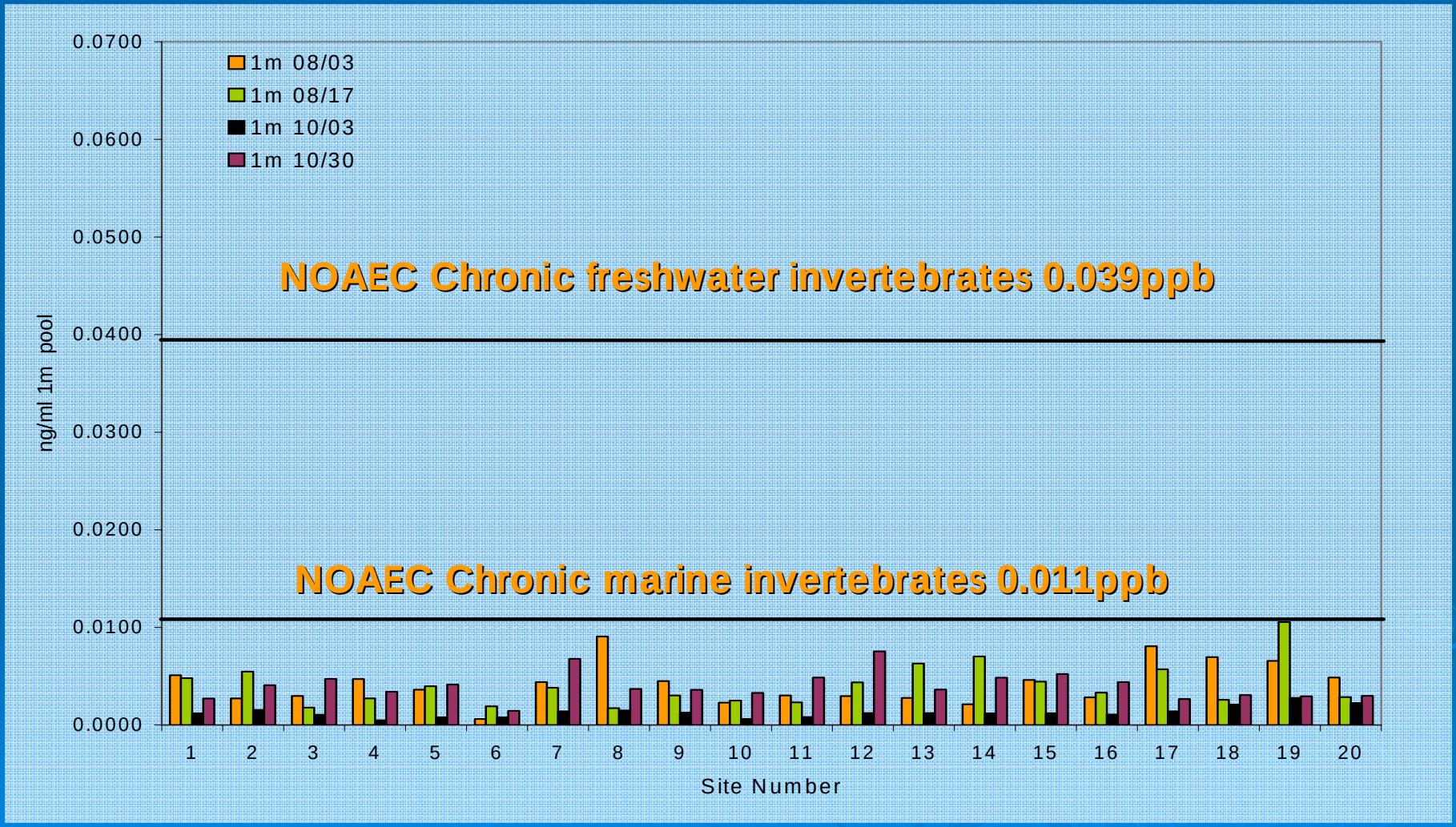
Concentration in a 6” pool



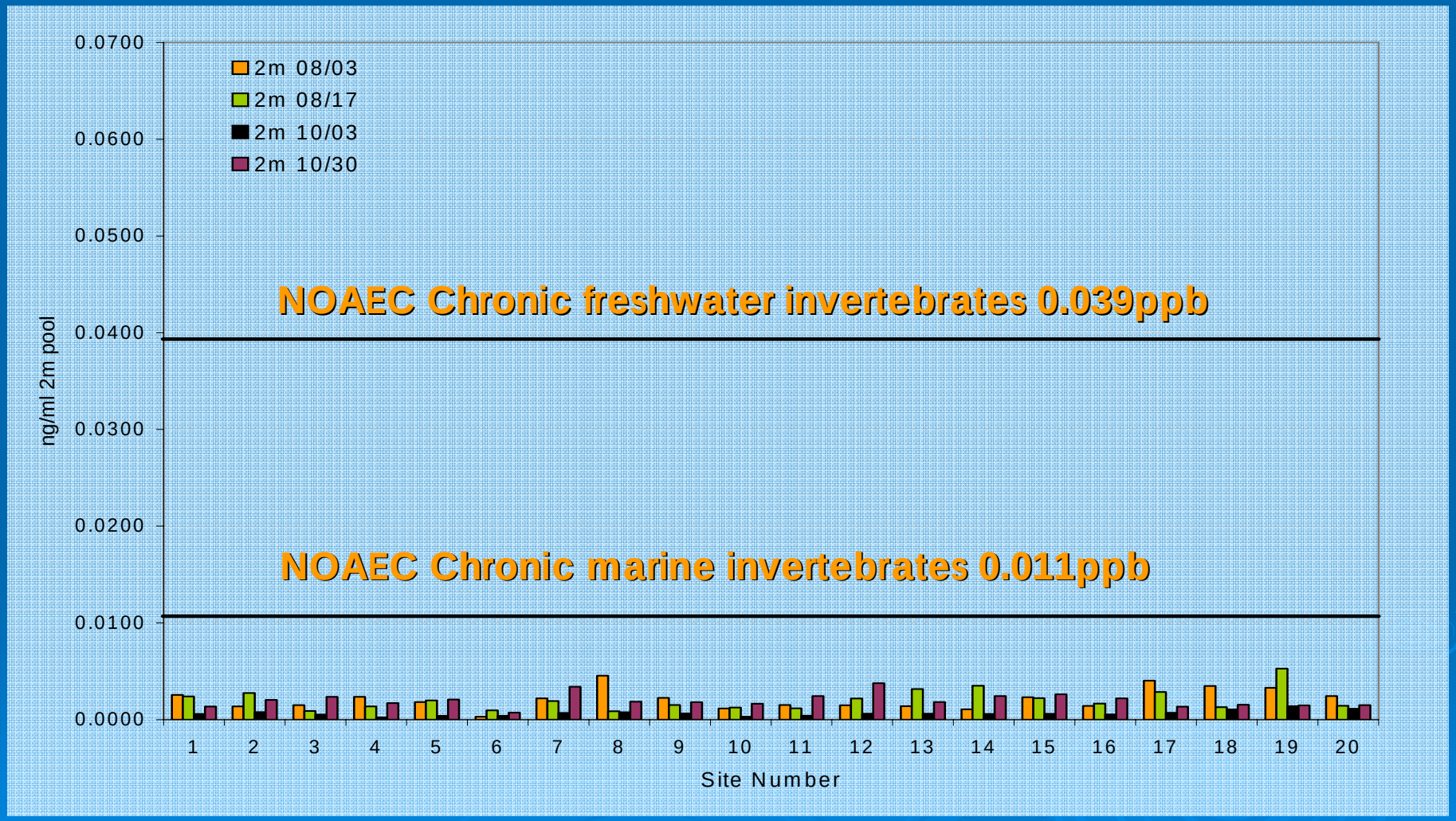
Concentration in a 1’ pool



Concentration in a 1m pool

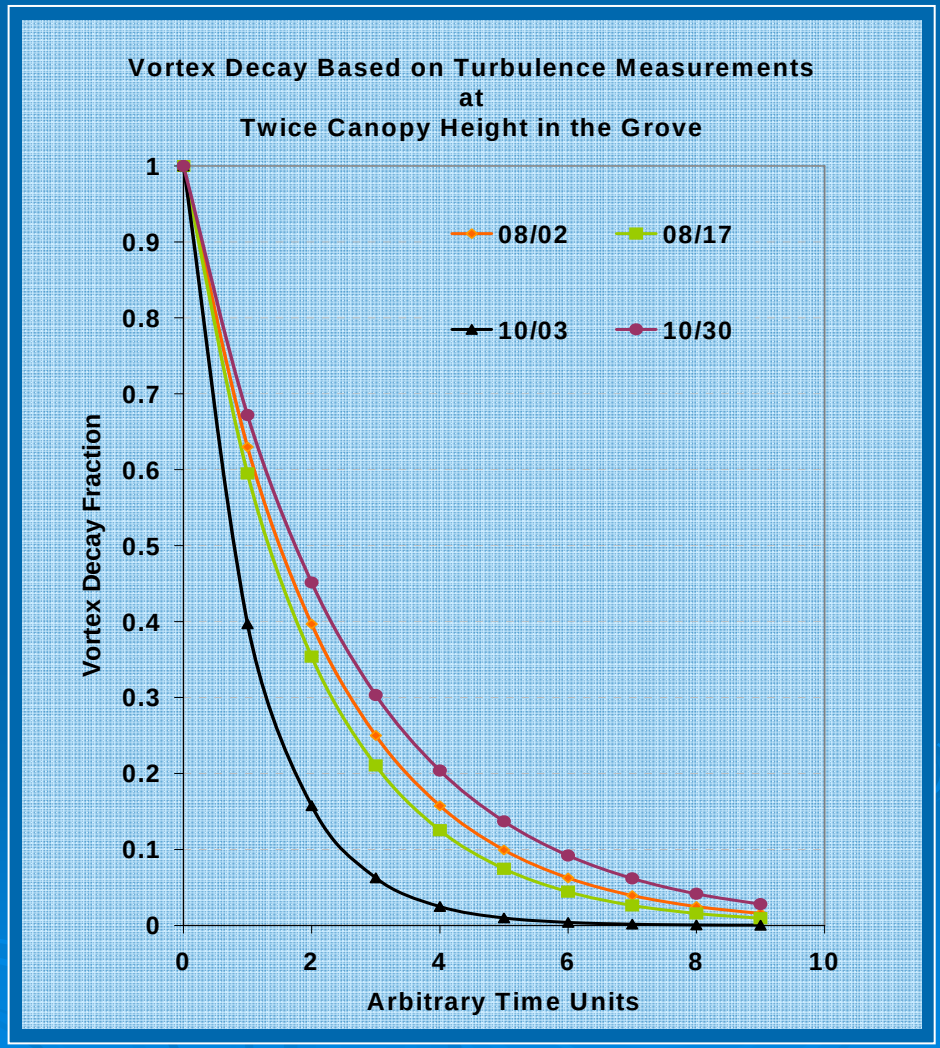


2m = eco-toxicological models



Vortical decay

- The stability at time of application strongly correlated with ground deposit values
- Neutral nights have increased wind speed and therefore vortical decay
  - There is a reduction in the time/distance which the spray is entrained before dissipation
- Stable nights the vortices decay slowly entraining more chemical forcing it into the ground



Tabulated Averages

- To be within the NOAEC 0.011ppb for marine invertebrates in shallow water you must have a Ri of close to 0.02 or appreciable wind
- If all water bodies are 1m or more in depth marine invertebrates unharmed
- All applications were safe for fresh water invertebrates NOAEC 0.039ppb

	6 inches	1 foot	1 meter	2 meters	Ri	U 7m m/s	U 2m m/s	q (m/s)	Mortality
3-Aug	0.0278	0.0139	0.0042	0.0021	0.19	1.16	0.14	0.39	99
17-Aug	0.0267	0.0133	0.0041	0.0020	0.33	0.7	0.27	0.44	85
3-Oct	0.0085	0.0043	0.0013	0.0006	0.02	2.04	0.38	1.08	2
30-Oct	0.0263	0.0131	0.0040	0.0020	0.37	0.96	0.06	0.34	43

Summary: Preliminary Thoughts

- **Stable nights slow vortical decay rate**
  - **Deposits: Vortices remain and entrain significant spray volume, meaning more chemical is physically forced down by the air craft, chemical not available to control mosquitoes**
- **Neutral nights increased vortical decay**
  - **Deposits: Vortices decay rapidly breaking above the canopy letting air currents take a significant portion of the spray, chemical available to control mosquitoes**

Further Work

- Test an out of ground effect altitude of 150ft
- Then increase the drop size distribution and re-investigate 100 and 150ft
- We are going to add a deposited droplet distribution measure, slides on ground
- Ultimately we will be working with a mono-sized droplet generator isolating the parameter of drop size
  - Meteorology is the only variable

Any Questions ?

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